WORKING THROUGH ASHRAE 62.2

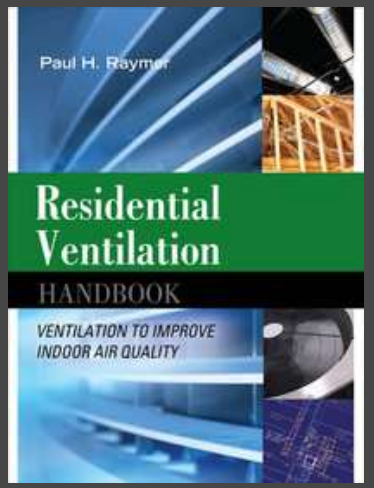
Ventilation for the Best of Us

Heyoka Solutions

Paul H. Raymer

Heyoka Solutions
Paul Raymer

- Located on Cape Cod, Massachusetts;
- Member of HVI, NESEA, RESNET
- Member ASHRAE 62.2 SSPC
- HERS Rater, BPI Analyst, Envelope, Heating, and AC/Heat Pump Certified;
- Energy Star V3 certified;
- IREC Assessor;
- Author of the "Residential Ventilation Handbook"



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62.2: What is it?

- National Ventilation Standard
- Single family, multifamily up to three stories, and manufactured and modular buildings;
- Considers chemical, physical, and biological contaminants but does not consider thermal comfort;
- Acceptable IAQ will not necessarily be achieved even if all requirements are met.

ASHRAE Standard 62.2-2003
ASHRAE STANDARD
Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

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62.2: What is it?

- Requires whole-building ventilation in all new and the majority of existing homes;
  - Provides sizing procedures;
  - Requires installed system testing;
  - Outlines equipment parameters.
- Requires local, exhaust ventilation in bathrooms and kitchens in all homes;
  - Provides sizing procedures;
  - Requires installed system testing;
  - Outlines equipment parameters.

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62.2: What is it?

- Requires interaction with adjacent spaces to be limited;
- Requires non-interference with atmospherically vented combustion appliances;
- Requires the system and its design to be documented for the building and the occupants.

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62.2: What is it?
Here it is in a nutshell!

- Select a whole building airflow from the table (or calculate it);
- Select appropriate airflow rates for local exhaust;
- Select quiet equipment whose performance is certified by HVI;
- Install it so it works;
- Test it to prove that it works.

"How hard can it be?"

Edward Brannock, Pilot & Entrepreneur

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Whole Building Ventilation

Size the system Table 4.1a

Example: 1400 square foot house with 2 bedrooms.
Requires 45 cfm continuous ventilation.

Floor Area (ft^2)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1500 ft^2	30	45	60	75	90
1501 – 3000	45	60	75	90	105
3001 - 4500	60	75	90	105	120
4501 - 6000	75	90	105	120	135
6001 - 7500	90	105	120	135	150
>7500 ft^2	105	120	135	150	165

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Whole Building Ventilation

Size the system – "Use the formula, Luke"

- Formula:
  - $Q_{fan} = 0.01A_{floor} + 7.5(N_{bedrooms} + 1)$

Example: Same 1400 square foot 2 bedroom house:
(1400 x .01) + 7.5 x (2 + 1) = 14 + 22.5 = 36.5 cfm

Slightly lower airflow, but remember that 62.2 is MINIMUM ventilation guideline. It assumes 2 occupants in the master bedroom.

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Local Exhaust

- "Local mechanical exhaust shall be installed in each kitchen and bathroom."

- Removes polluted air at the source;
- Spot ventilation systems may be noisier than whole building ventilation systems;
- In some cases the fan noise is desirable.

Courtesy of eHow, Inc.

Note that local exhaust can serve as all or part of whole building ventilation.

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Local Exhaust
Rates

	Intermittent	Continuous
Kitchen	100 cfm Vented range hood required if exhaust fan flow rate is less than 5 kitchen ACH	5 ACH
Bathroom	50 cfm	20 cfm

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Select the Equipment
Whole Building Ventilation - Type

- Select equipment with performance certified by AMCA or HVI;
- Very quiet: 1 sone or less.
- Exhaust or Supply only ventilation;
- Mechanically balanced ventilation;
- Mechanically balanced ventilation with heat or energy recovery.

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62.2-2010 Controls
Whole Building Ventilation

- "The 'fan on' switch on a heating or air-conditioning system . . . for systems introducing ventilation air through . . . an HVAC system";
- "Readily accessible override control must be provided to the occupant";
- "Local exhaust fan switches and 'fan on' switches . . . as override controls";
- "Controls, including the 'fan-on' switch of a conditioning system, must be properly labeled."

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Install it so it works.

- Air is lazy;
- Electrons are more forgiving;
- Never use “duck” tape;
- Always choose the shortest, straightest path to the outside;
- System must be serviceable;
- Never, never, never vent into the attic.

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Install it so it works.

- In-line fans are designed to drag air through ducts;
- Propeller or axial fans are not good for ducts;
- Backdraft dampers can cut the airflow in half.

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Install it so it works.

Duct Lengths (ASHRAE 62.2 Table 5.3)

- Maximum allowable length at different flow rates;
- This table assumes no elbows. Deduct 15 feet of allowable duct length for each elbow;
- NL = no limit X = not allowed. Any length of duct this size with assumed turns and fittings will exceed the rated pressure drop.

Duct Type	Flex Duct				Smooth Duct			
Fan Rating	50	80	100	125	50	80	100	125
Diameter	Maximum Length							
3″	X	X	X	X	5	X	X	X
4″	70	3	X	X	105	35	5	X
5″	NL	70	35	20	NL	135	85	55
6″	NL	NL	125	95	NL	NL	NL	145
7″ & Above	NL	NL	NL	NL	NL	NL	NL	NL

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Install it so it works.

Duct Lengths (Table 5.3)

Example: Bath fan needs 50 cfm for intermittent operation.
Straight run – no elbows and no hood: up to 70 feet of 4″ diameter flex should work
But add two 90 degree elbows and a 90 degree flow hood =
70 + (15 + 15 + 15) = 105 feet.
Or move up to 5″ or 6″ ducting.

Duct Type	Flex Duct				Smooth Duct			
Fan Rating	50 cfm	80	100	125	50	80	100	125
Diameter	Maximum Length							
3″	X	X	X	X	5	X	X	X
4″	70	3	X	X	105	35	5	X
5″	NL	70	35	20	NL	135	85	55
6″	NL	NL	125	95	NL	NL	NL	145
7″ & Above	NL	NL	NL	NL	NL	NL	NL	NL

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Test the airflow

"The airflow required by this section is the quantity of indoor air exhausted by the ventilation system as installed and shall be measured using a flow hood, flow grid, or other airflow measuring device." 62.2-2010

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Test the airflow

Large vane anemometer $499
+ funnel kit $235

Hot wire anemometer $699

Balometer $1,535

TEC Exhaust fan flow meter $135
Plus DG700 Manometer $825

Evaluation of flow hood measurements for residential register flows

http://epb.lbl.gov/publications/lbnl-47382.pdf

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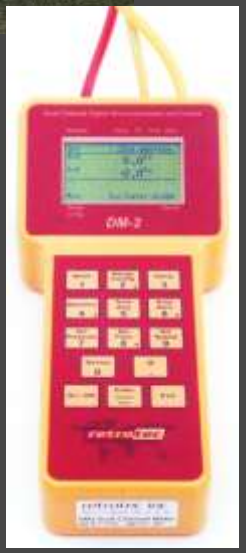
Test the airflow

Duct Blaster with DG700

Q32 Duc-Tester
with DM-2 gauge



Flow Blaster with DG700

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Other requirements
Just a few other things

- Basically you're done. But you do need to consider . . .

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Reduce the whole building flow with the Infiltration Credit

- If the home has had a blower door test, the actual infiltration can be used to adjust the ventilation rate.
- $((CFM_{50}/N) - (A_{floor} \times 0.02)) \times ½ =$ infiltration credit

CFM_{50} is the blower door number

N is calculated from the Standard 136 weather factors

A_{floor} is the area of the floor

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Infiltration Credit

- $((CFM_{50}/N) - (A_{floor} \times 0.02)) \times ½ =$ infiltration credit
- (CFM_{50}/N) must be greater than $(A_{floor} \times 0.02)$
- $N_{factor} = 1/(0.0508 \times W_{factor} \times Floor_{factor})$

Pennsylvania	1 story	1.5	2	2.5	3
Allentown	24.6	21.8	20.0	18.7	17.7
Erie	19.7	17.4	16.0	15.0	14.2
Harrisburg	25.9	22.9	21.0	19.7	18.6
Philadelphia	23.2	20.5	18.8	17.6	16.7
Pittsburgh	23.2	20.5	18.8	17.6	16.7

Pennsylvania 'N' Factors calculated from Standard 136

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Whole Building Ventilation
Size the system

- Example:
  - 1400 square foot;
  - 2 bedroom house;
  - Located in Philadelphia;
  - Measured CFM_{50} = 1200

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Infiltration Credit Example

- 2 Bedroom, 1400 square foot, single story house in Philadelphia, 1200 CFM_{50}:

#BR + 1 = 3	7.5 cfm	22.5 cfm
1400 Square feet ÷ 100		14 cfm
Total whole building airflow req. from 62.2 formula*		**36.5 cfm**
Blower Door 1200 CFM_{50}	N = 23.2	1200 ÷ 23.2 = 51.7 cfm
1400 square feet X 0.02		1500 x 0.02 = 28
	Difference	51.7 – 28 = 23.7
	Infiltration credit	23.7 ÷ 2 = 11.8
Whole building	Req. ventilation	36.5 – 11.8 = **25 cfm**

$$*Fan\ airflow = 0.01Area_{floor} + 7.5(N_{br} + 1)$$

Need a 25 cfm fan running continuously.
Spot ventilation also required.

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Adjust the whole building flow in Existing Buildings
Appendix A

Gives credit for existing fans and operable windows and infiltration.

Rather than replace existing, underpowered fans, increase the whole building rate and leave the fans in place.

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Existing Buildings (Appendix A)

Modified whole building ventilation rate is the sum of the whole building rate from Table 4.1 plus any deficit for existing, underpowered local exhaust fans minus an infiltration credit.

1. Get the required airflow from the whole building table;
2. Adjust the rate for an existing fan in a bathroom or kitchen;
3. Adjust the rate for a window in a bathroom or kitchen;
4. Reduce the whole building flow rate with the Infiltration Credit.

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Existing Buildings (Appendix A) Example

- Existing 2 bedroom, 1400 ft^2, single story home in Philadelphia, PA;
- Bathroom has an existing fan with 25 cfm measured airflow and an operable window;
- Kitchen has an existing range hood with 70 cfm measured airflow and an operable window;
- Fans can be left in place and a new primary ventilation fan can be added to satisfy the whole building ventilation rate plus the *deficit* in the local ventilation.
- Calculate the total *deficit* and divide by 4.

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Existing Buildings (Appendix A)

Information necessary for making the airflow calculation with existing fans:

Required parameter	
Location	Philadelphia, PA
Number of stories	1
Location N factor	23.2
Number of bedrooms	2
Floor area	1400 ft^2
Kitchen fan measured airflow	70 cfm
Kitchen window	Yes
Bathroom fan measured airflow	25 cfm
Bathroom window	Yes
Blower Door Test	1200 CFM_{50}

Pennsylvania 'N' Factors

Penn.	1 story	1.5	2	2.5	3
Allentown	24.6	21.8	20.0	18.7	17.7
Erie	19.7	17.4	16.0	15.0	14.2
Harrisburg	25.9	22.9	21.0	19.7	18.6
Philadelphia	23.2	20.5	18.8	17.6	16.7
Pittsburgh	23.2	20.5	18.8	17.6	16.7

Note: 'N' factors include weather information from ASHRAE 136.

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Existing Buildings (Appendix A)

First calculate whole building ventilation needed from the formula, adding:

1. Number of bedrooms + 1 x 7.5 cfm plus;
2. 1 cfm per 100 ft² of floor area;

Whole Building Ventilation needed:
2 bedrooms +1

3	7.5 cfm	22.5

Square feet/100

1400	100	14.0
	Total	36.5 cfm

Then calculate Existing Ventilation and Deficit:

	Req.	Window	Existing Fan	Difference
Kitchen with a window and 70 cfm range hood. >	100	- 20	- 70	10
Bath with a window and 25 cfm exhaust fan. >	50	- 20	- 25	5
		Total Deficit		15
			Deficit/4	3.75
Ventilation Needed 37.5 + 3.75 =				40.25 cfm

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Existing Buildings Appendix A

Reduce the flow with the Infiltration Credit
= ½ difference between measured $CFM_{natural}$ and 2% of the floor area

CFM_{50}	N value	Natural Leakage ($CFM_{natural}$)
1200	23.2	1200/23.2 = 51.7 cfm

Calculate floor area x 0.02

1400 ft^2	0.02	1400 x .02 = 28.0
Difference		51.7 – 28 = 23.7
Infiltration credit		23.7 ÷ 2 = 11.85

Ventilation to Add

Ventilation Needed – Infil credit	40.25 – 11.85 = **29.4** cfm

Need an extra 30 cfm fan running continuously.
Leave existing fans in place.

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6.5 Airtightness Requirements

- Garages: separating walls and doors must be caulked, gasketed, weather-stripped, wrapped or otherwise sealed to prevent or limit air movement.
- Space-conditioning ducts: “HVAC systems that include air handlers or ducts located outside the pressure boundary shall have total duct leakage of no more than 6% of total fan flow when measured at 0.1 in. w.c. (25 Pa)”.

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6.1.1 Multifamily buildings

- "All doors between dwelling units and common hallways shall be gasketed or made substantially airtight with weather stripping . . . ."

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6.4 Combustion and solid fuel burning appliances

- "Combustion and solid-fuel burning appliances must be provided with adequate combustion and ventilation air".
- "the total net exhaust flow of the two largest exhaust fans . . . shall not exceed 15 cfm/100 ft^2 of occupiable space when in operation at full capacity."

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Combustion and solid fuel burning appliances

Example: 1400 ft^2 house with a fireplace and a 270 cfm range hood;

1400/100 = 14

14 x 15 cfm = 210 cfm

270 cfm > 210 cfm

Reduce the airflow (install a different range hood) or provide “compensating outdoor airflow”.

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6.2 Instructions and Labeling

- "Information on the ventilation design and/or ventilation systems installed, instructions on . . . operation . . . and detailing any required maintenance shall be provided to the owner and the occupant."
- "Controls shall be labeled as to their function (unless that function is obvious such as toilet exhaust fan switches."

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Instructions and Labeling

Information package should include:

- ✓ Design parameters including:
  - ✓ ventilation calculations, heating/cooling load, energy calculations, safety calculations, permit documentation, approach being used, operating schedule;
- ✓ Mechanical ventilation equipment information including:
  - ✓ operation, maintenance, and installation/owner's manuals
  - ✓ make, model, size, and supplier for all equipment
  - ✓ electrical requirements
  - ✓ emergency contact names and numbers

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Instructions and Labeling

Information package should include:

- ✓ Natural and passive devices:
  - ✓ operation, maintenance, and installation/owner's manuals;
  - ✓ make, model, size, and supplier for all equipment;
  - ✓ Limitations on the acceptability of IAQ if natural ventilation devices are not operated as intended;
- ✓ Control equipment information including:
  - ✓ operation, maintenance, and installation/owner's manuals;
  - ✓ make, model, size, and supplier for all equipment;
  - ✓ control strategy.

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Instructions and Labeling

System Design:

Floor Area	# of Bedrooms + 1	Whole Building CFM		
1400	2+1=3	36.5		
Combustion CFM Threshold	15 cfm/100 square feet	210 cfm		
Cat 1 Combustion Appliances	Location	Installed outdoor air supply (yes/no/NA)		
DHW	Basement	Yes	No	NA
Furnace	Basement	Yes	No	NA
Boiler		Yes	No	NA
Fireplace	Living Room	Yes	No	NA
Other		Yes	No	NA

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Instructions and Labeling

Whole Building Ventilation System Type:

System Choice	✓	Date Installed	System Location			Balanced @ Install
Exhaust-only						NA
Supply-only						NA
Balanced				#supplies	#returns	
HRV	✓	9/15/11	Basement	3	3	✓
ERV						
Supply to air-handler						NA

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Instructions and Labeling

Ventilation Product Information:

Brand	Model ID	Required Airflow	Tot. Installed Airflow Normal	Boost
Fanwho	Quantum 3	36.5	42	76

Control:

Brand	Model ID	Function (Multi-speed, intermittent, etc.)
Fanwho	IAQ4040	Multi-function, variable flow

System Function & Operating Notes	HRV designed to exhaust air from the bathrooms and supply air to the bedrooms, low speed continuous operation, manual boost.
Req. Maintenance	Clean filters monthly. Replace annually.
	Clean the core annually.

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Instructions and Labeling

Local Exhaust Ventilation System Type:

System Choice	✓	Date Installed	System Location			Balanced @ Install
Exhaust-only	✓	9/15/11	Kitchen			NA
Supply-only						NA
Balanced				#supplies	#returns	
HRV						
ERV						
Supply to air-handler						NA

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Instructions and Labeling

Local Exhaust Ventilation Information:

Location	Brand	Model ID	Req. Airflow	Installed Airflow Normal	Boost
Kitchen	Whambam	Gourmet 1230	100	150	270
M. Bath					
Bath 2					
Bath 3					

Local Exhaust Controls:

Location	Brand	Model ID	Function
Kitchen	Whambam	Built In	
M. Bath			
Bath 2			
Bath 3			

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Instructions and Labeling

System designer contact name & numbers:

Company Name:	*Elite Ventilation Design*
Contact Person:	*Edward Mainspring*
Street, City, State, Zip:	*1 Best Street, Philadelphia, PA 19143*
Office phone:	*555-555-7321*
Cell Phone:	
Email:	*EDM@EliteVentilationDesign.com*

Installing contractor contact name & numbers:

Company Name:	*Big Mike's Fans*
Contact Person:	*Mike "Moose" Newman*
Street, City, State, Zip:	*12 Main St., Philadelphia, PA 19143*
Office phone:	*555-555-1237*
Cell Phone:	*555-555-1238*
Email:	*moose@mikesfans.com*

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Equipment Notes

Couple more things about equipment . . . .

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Equipment

- HVI testing: Home Ventilating Institute 920 *Product Performance Certification Procedure Including Verification and Challenge* and
- HVI 915 *Procedure for Loudness Rating of Residential Fan Products*

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So, 62.2 how hard can it be?

1. Select the whole building ventilation rate based on Table 4.1.
   a) Or you could use the formula;
   b) If it's an existing building, you could use Appendix A to get credit for existing fans and windows;
   c) You could reduce the flow a bit more by calculating the infiltration credit.
2. Select the local exhaust fans – continuous or intermittent;
   a) You could use the whole building fan to satisfy both.

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How hard can it be?

2. Select the local exhaust fans – continuous or intermittent;
   a) You could use the whole building fan to satisfy both.
3. Install them right – gotta do that way anyway.
   a) Make sure the air is moving to and from outside the building;
4. Document the system and inform the homeowner what it's for and how important it is.

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ASHRAE 62.2 Resources

www.ASHRAE.org

62.2 User's Manual – available through Resources & Publications
$54.00
Detailed step-by-step user guide through the Standard

ASHRAE Guideline 24-2008
$54.00
Beyond the Standard – details on IAQ, commissioning, and documenting

Residential Ventilation Handbook, Paul H. Raymer, McGraw-Hill, 2010
$52.45

62.2 System Checklist, Infiltration Credit & Existing Homes Credit spreadsheet, System Documentation Sheet
www.HeyokaSolutions.com

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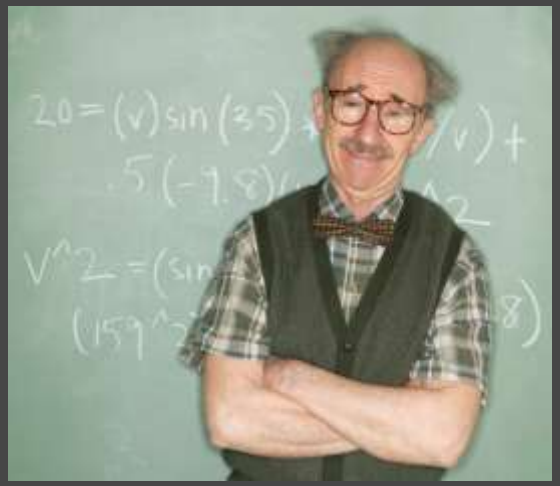
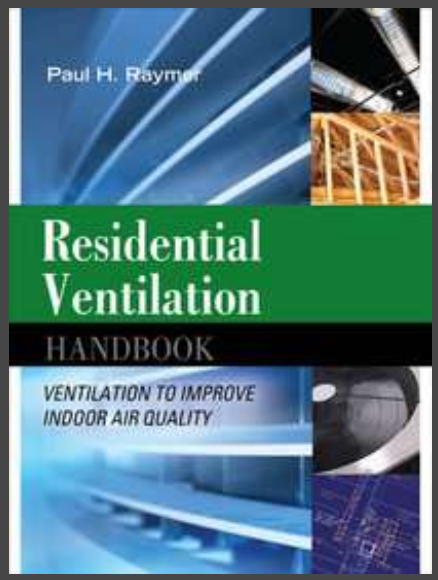
. . . and that's the name of that tune!





Read the book.
Don't wait for the movie!

www.HeyokaSolutions.com

Go to: HeyokaSolutions.com
"Tools we use"
"Worksheets and Checklists"
For "Auditor/Inspector Checklist"
"Ventilation System Documentation Form"
"ASHRAE 62.2 Whole Building Ventilation Calculation Sheet"

Thanks for listening

Paul Raymer
paul.raymer@heysol.com

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